SEMESTER – II
FOOD FERMENTATION AND TECHNIQUES- THEORY

1. Course Description

Course Code: P24/MIC/DSC/203
Type of Course: DSC
No. of credits: 3

Max. Hours: 45
Hours per week:3
Max. Marks: 100

2. Course Objectives:

1. To identify and explain current topics of importance to the food industry and emphasize the spoilage microbes in foods. To know about important principles in food preservation.
2. To apply and evaluate the strategies to prevent transmission of common food borne illnesses, develop fermented food products and understand the concept of Food safety, food laws associated with its safety.

3. Course Outcomes:

CO1: Understand food spoilage and the role of food preservation techniques in reducing the spoilage . (L II)

CO 2 : Analyze and evaluate the biochemistry of fermented food products and the importance of nutraceuticals in improvement of health (L IV ,V)

CO 3 : Apply the relevance of microbial standards for food safety, quality assurance and evaluate the quality of food based on the good manufacturing practices followed in the industry (LIII)

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4. Course Content

MODULE I - FOOD MICROBIOLOGY: AND PRESERVATION METHODS (15 Hrs)

Microorganisms in Food : Biochemical changes caused by microorganisms – putrefaction, lipolysis, antagonism and synergism in microorganisms, Preservation Methods: Food preservation by low temp: freeze-drying; heating: drying, osmotic dehydration, blanching, canning, pasteurization. Non-thermal preservation: Hydrostatic pressure, dielectric heating, hurdle technology, membrane technology (reverse osmosis and ultra filtration), irradiation

MODULE II - INDUSTRIAL FOOD FERMENTATION: (15 Hrs)

Starter cultures their biochemical activities, production and preservation of the following fermented foods. Soy sauce fermentation by Moulds, bread. Fermented vegetables- Sauerkraut. Fermented milk products - kefir, butter. Biosensors in food. **Nutraceuticals:** Introduction - Definition, history, classification - Type of classification: Probiotics, Prebiotics and Synbiotics, fortification, 3D printing in food industry -an overview.

MODULE III - FOOD SAFETY AND QUALITY : (15 Hrs)

Food Hygiene – Food-borne Infections & Intoxications, microbiological methods for examination of foods , Concept of food safety and quality; Quality attributes, Quality Control & Assurance – Objectives; Functions; GMP, GHP, GLP, GAP, HACCP; Indian and International Quality Systems and Standards (BIS, ISO, Codex Alimentarius, Codex India, etc.); CEDAC; Food Adulteration, Bioterrorism

5. Resources:

Text Books:

1. Frazier, Food Microbiology (1987) Tata McGraw-Hill Education,

2. M.R. Adams & M.O. Moss(2008) Food Microbiology,Royal Society of Chemistry,.

3. Joanne Willey, Linda Sherwood, Chris Woolverton (2010) Prescott's Microbiology. McGraw Hill Education; 8th edition

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4. A.H.Patel(2011) Industrial Microbiology, Macmillan India Limited; Second edition
5. S.M.Reddy ,Basic food Science and Technology,New Age International (P) Ltd
6. Robert E.C. Wildman, Robert Wildman, Taylor C. Wallace(2000), Handbook of Nutraceuticals and Functional Foods, Third Edition,CRC Press.
7. Bibek Ray (1996). Fundamental Food Microbiology
8. Early R.1995.Guide to Quality Management Systems for Food Industries. Blackie Academic.

Reference Books:

1. Madigan et al, (2010),Brock's Biology of Micro organisms Benjamin Cummings; 13 edition
2. R. Fuller, G. Perdigon (2001),,Probiotics 3 Kluwer Academic Publishers.
3. Doyle (2012),Food Microbiology: Fundamentals and Frontiers ,ASM Press; 4th edition
4. Joshi(2009),Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology.Volume 2 ,Educational Publishers & Distributors,.
5. John Garbult (1997),Edited Essentials of Food Microbiology,Arnold International Students Edition. 2 edition, CRC Press;
6. Abigail A.Salyers and Dixie D. Whitt (2001) ,Bacterial Pathogenesis A Molecular Approach. 2 nd Edition. by. ASM Publications.
7. R.C Dubey, D.K Maheshwari,(2011),Practical Microbiology, S Chand and Company, New Delhi.
8. Gopal Reddy *et al,(*2008) Laboratory experiments in Microbiology,3rd edition,Himalaya publishers..
9. FSSAI(2012),Manual on methods of analysis of foods.
10. Principles of Food Toxicology (2008) by T. Pussa.
11. Essentials of Toxicology (2011) by V. K. Matham.
12. Toxicology (2009) by Y.K. Lahi

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6. Syllabus Focus:

a) Relevance to Local, Regional, National, and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
National	Ensuring Food safety and understanding importance of food safety in food processing

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Entrepreneurship Development	Module 2	Develop fermented foods with rich nutrient content. Activity: Fermented foods preparation and assessment of their biochemistry in providing nutritional benefits

7. Pedagogy:

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Presentations	Participative learning
2.	Animations	Participative learning
3.	Case studies	Problem solving

8. Course Assessment Plan:

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

COs	Continuous Internal Assessments - CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1	
C03	CIA-2 Fermented food production	

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b. Question Paper Pattern :

FOOD FERMENTATION AND TECHNIQUES
MODEL QUESTION PAPER - THEORY

Course Code: P24/MIC/DSC/203 **Max Marks: 60**
Credits: 3 **Time: 2 ½Hrs**

SECTION – A

I. Answer the following: **3 x 12 = 36M**

1. Explain biochemical changes in Food spoilage

OR

2. Describe food preservation by low-temperature.

3. Analyze the biochemistry of sauerkraut fermentation

OR

4. Explain and analyze the significance of added nutrients in foods for the treatment of diseases, .

5. Describe food safety.

OR

6. Explain Bioterrorism.

SECTION – B

II. Answer any FOUR **4 x 6 = 24M**

7. Describe Pasteurization
8. Illustrate Blanching process
9. Explain 3D printing in food
10. Explain Biosensors in food
11. Explain food intoxication
12. Explain HACCP System

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SECTION A - INTERNAL CHOICE				3Q X 12 M = 36 M
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain biochemical changes in Food spoilage	CO 1	Level II
2	Module 1	Describe food preservation by low-temperature.	CO 1	Level I
3	Module 2	Analyze the biochemistry of sauerkraut fermentation	CO 2	Level IV
4	Module 2	Explain and analyze the significance of added nutrients in foods for the treatment of diseases,	CO 2	Level IV
5	Module 3	Describe food safety.	CO 3	Level I
6	Module 3	Explain Bioterrorism	CO 3	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)				4 Q X 6M = 24M
7	Module 1	Describe Pasteurization	CO 1	Level I
8	Module 1	Illustrate Blanching process	CO 1	Level II
9	Module 2	Explain 3D printing in food	CO2	Level II
10	Module 2	Explain Biosensors in food	CO 2	Level II
11	Module 3	Explain food intoxication	CO3	Level II
12	Module 3	Explain HACCP System	CO 3	Level II

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SEMESTER – II
FOOD FERMENTATION AND TECHNIQUES- PRACTICAL

1. Course Description :
Course Code: P24/MIC/DSC/203/P
Course Type: DSC
No. of Credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To comprehend the role of the microorganisms in spoilage of foods and methods of their identification.
- To gain knowledge about the beneficial role of microorganisms and different types of fermented foods.
- To assess quality of the food based on regulatory standards.

3.Course outcomes:

CO1: Understand the laboratory techniques to detect, quantify, and identify microorganisms in foods

CO2: Understand the role of fermentation microorganisms in food fermentations;

CO3: Analyze types of spoilage and their impact on the quality and safety of food.

List of Practicals

1. Enumeration of microorganisms in foods by aerobic plate count method.
2. Sauerkraut fermentation.
3. Detection of endotoxins in food samples by Limulus Amoebocyte Lysate test.
4. Detection and determination of coliforms, fecal coliforms and E.coli in foods and beverages.
5. Determination of Aciduric flat sour spore formers in canned foods.
6. Estimation of yeasts and molds in foods and beverages
7. Detection and Determination of thermophilic flat sour spore formers
8. Detection of osmophiles in foods

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9. Detection of quality of milk by rezazurin dye test

10. Isolation, identification and characterization of probiotic lactic acid bacteria from milk products.

11. Food safety standards: ISO 9000, ISO 22000,ISO 15161, ISO 14000,FSSAI regulations for foods.

MODEL QUESTION PAPER – PRACTICAL

Course Code: P24/MIC/DSC/ 203/P **Max Marks: 50**
Credits: 2 **Time: 3 Hrs**

I. Major: **1X20= 20 M**

A. Estimate the amount of acetic acid with 0.02 N NaOH present in the given sauerkraut sample.

B. Estimate the amount of lactic acid with 0.1 N NaOH present in the given sauerkraut sample.

II. Minor: **1X10= 10 M**

i) Enumerate the no. of microorganisms in the given solid food sample by aerobic plate count method.

ii0 Enumerate the no. of aciduric flat sour spore formers in canned foods provided to you.

III. Spots **5x2=10M**

IV. Record **5M**

V. Viva **5M**

Prepared by Faculty	Checked &Verified by HoD	Approved by the Principal
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SEMESTER - II

MOLECULAR BIOLOGY AND MICROBIAL GENETICS - THEORY

1. Course Description:

Programme: M.Sc **Max. Hours: 45**
Course Code: P24/MIC/DSC/201 **Hours per week: 3**
Course Type: DSC **Max. Marks: 100**
No. of credits: 3

2. Course Objectives:

- To Understand the structure, types, replication, damage & repair of DNA, Mutagenesis, transcription, genetic code, Protein synthesis and gene regulation.
- Enable the student to acquire knowledge on Transposons, cloning procedures, Plasmids, vectors artificial chromosomes and construction of cDNA libraries and gene transformation methods.

3. Course Outcomes:

CO1: Understand the structure, properties, replication & repair of DNA, Mutagenesis, Transcription, Genetic code and organization of prokaryotic and eukaryotic Genome Organization. (L II)

CO2: Understand Protein synthesis, Gene regulation in Prokaryotes and Eukaryotes and Molecular mechanisms of gene transfer. (L II)

CO3: Apply the conceptual knowledge of Transposons, Plasmids, properties of vectors, cloning process, genomic and cDNA library construction and screening in industrial process (L III)

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4. Course Content:

MODULE I – NUCLEIC ACID STRUCTURE, BIOSYNTHESIS AND DNA REPAIR: (15 Hrs)

Basics structure of DNA, Genome organization in prokaryotes and eukaryotes.

Prokaryotic replication Mechanism: enzymes involved in replication, step by step process. Eukaryotic telomere replication. DNA damage and repair mechanism. Mutagenicity testing using microbial systems. site directed mutagenesis, reverse genetics. Prokaryotic and eukaryotic transcription. Processing of t-RNA, r- RNA, m -RNA splicing. Genetic code and Wobble hypothesis.

MODULE II- TRANSLATION, GENE REGULATION AND GENE TRANSFORMATION: (15 Hrs)

Translation in prokaryotes and Eukaryotes. Post translational modification. Gene regulation and expression – lac operon, arabinose and tryptophane operons.

Gene regulation in eukaryotic systems, role of promoters, enhancer elements. Bacterial transformation and recombination- discovery, detection, molecular mechanisms of transformation.

Bacterial conjugation- sex factor in bacteria, F and HRF transfer, mechanism of transfer, linkage mapping, mechanism of recombination. Bacterial transduction- transduction phenomenon, methods of transduction, co- transduction, generalized, specialized and abortive transduction, sexduction and their applications.

MODULE III - TRANSPOSONS, PLASMIDS AND CLONING STRATEGIES: (15 Hrs)

Transposable elements -Definition, detection of transposition in bacteria, types of bacterial transposons and application of transposons. Extra chromosomal elements-plasmids, types, isolation, identification and detection.

Cloning and expression vectors based on plasmids, phagemids and cosmids, phages. Viruses, artificial chromosomes (YAC's), shuttle vectors. Principle and applications. Construction and screening of genomic, cDNA libraries.

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5. Resources:

Textbooks:

1. James D. Watson Tania A. Baker, Stephen P. Bell Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.
2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.
3. David Freifelder1986 Molecular Biology 3rd edition, Jones & Bartlett Publishers
4. T.A. Brown, Gene cloning and DNA analysis- An Introduction, 4thedition
5. Bernard R. Glick and Jack. J. Pasternak, Molecular Biotechnology. 3rdedition

References Books:

1. Robert Weaver, (2011), Molecular Biology 5thedition, McGraw-Hill publication.
2. David Latchman, Taylor &Francis,(2007) Gene regulation, 5th edition, Taylor and Francis group publication.
3. David Freifelder, Stanley R. Maloy, John E. Cronan, (1994),Microbial genetics 2nd edition, Jones and Bartlett Publishers.
4. Joseph Sambrook, David William Russel, (2006), The Condensed Protocols from Molecular Cloning: a Laboratory Manual, Cold spring harbor laboratory press.
5. Davidson JN, (1972), The Biochemistryofnucleicacids7thedition, AcademicPress, New York
6. Sandy B. Primrose, Richard Twyman,(2006) Principles of Gene Manipulation and Genomics. 7th edition, Wiley publishers.
7. Mark Schena, (2007) DNA Microarrays: Methods Express Series, revised edition, Scion Publishing

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6. Syllabus Focus:

a. Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	In recent decades, advances in methods in molecular biology and genetics have revolutionized multiple areas of the life and health sciences. It remains as a global need for the development of more refined and effective methods across these fields of research. The current course presents articles related to novel molecular biology and genetics techniques developed by scientists from around the world.

b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Skill Development	Module III	Presentations on Transposons, Plasmids, Cloning vectors and DNA libraries would help the students to understand their applications and design vectors which will help them to develop related skills.

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7. Pedagogy :

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Seminar Presentation	Participative Learning
2.	Designing your experiment	Experiential Learning
3.	Case studies	Problem solving

8. Course Assessment Plan :

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA1-Written Exam	End semester exam
CO2	Skill test: Assignment	
CO3	Skill test: Problem solving	

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b. Question Paper Pattern

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

MODEL QUESTION PAPER- THEORY

Course Code: P24/MIC/DSC/201 **Max Marks: 60**
Credits: 3 **Time: 2 ½ Hrs**

SECTION – A

I. **Answer the following** **3 x 12 = 36 M**

1. Discuss in detail the mechanism of Prokaryotic transcription.

OR

2. Discuss in detail the mechanism of replication of DNA and various enzymes involved in the process.
3. Describe in detail the process of gene expression and regulation in prokaryotes with reference to Lac operon.

OR

4. (a) Explain in detail the process of conjugation.
   (b) In and interrupted mating experiment, it is seem that the after 10 min AziR gene in recipient, after 20 min there is appearance of tonR and after 15 min the recipient is lac+, but the recipient is almost never his+. Apply your knowledge to map the gene order and Where in the genome is the ori of transfer located.

5. Discuss in detail the concept of transposable elements.

OR

6. Describe the principle and applications of the YAC vectors in construction of Genomic DNA library

SECTION – B

II. **Answer any Four:** **4 x 6 = 24 M**

7. Write notes on Prokaryotic genome organization.
8. Describe about Telomerase.
9. Explain Bacterial transformation
10. Write notes on Recombination
11. Describe Plasmid Vectors.
12. Explain Bacterial transposons.

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Discuss in detail the mechanism of Prokaryotic transcription	CO 1	Level II
2	Module 1	Discuss in detail the mechanism of replication of DNA and various enzymes involved in the process.	CO 1	Level II
3	Module 2	Describe in detail the process of gene expression and regulation in prokaryotes with reference to Lac operon	CO 2	Level II
4	Module 2	a) Explain in detail the process of conjugation. b) In and interrupted mating experiment, it is seem that the after 10 min AziR gene in recipient, after 20 min there is appearance of tonR and after 15 min the recipient is lac+, but the recipient is almost never his+. Apply your knowledge to map the gene order and Where in the genome is the ori of transfer located.	CO 2	Level IV
5	Module 3	Discuss in detail the concept of transposable elements	CO 3	Level II
6	Module 3	Describe the principle and applications of the YAC vectors in construction of Genomic DNA library	CO 3	Level III
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			4 Q X 6M = 24M	
7	Module 1	Write notes on Prokaryotic genome organization	CO 1	Level II
8	Module 1	Describe about Telomerase	CO 1	Level II
9	Module 2	Explain Bacterial transformation	CO 2	Level II
10	Module 2	Write notes on Recombination	CO 2	Level II
11	Module 3	Describe Plasmid Vectors	CO 3	Level II
12	Module 3	Explain Bacterial transposons	CO 3	Level II

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SEMESTER – II
MOLECULAR BIOLOGY & MICROBIAL GENETICS - PRACTICAL

1. Course Description:

Course Code: P24/MIC/DSC/201/P
Course Type: DSC
No. of Credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To give hands on experience to isolate DNA, RNA and Plasmids
- To isolate mutants and carryout the process of screening.

3.Course Outcomes:

CO1: Extract, purify and determine the molecular weight of DNA, RNA and Plasmid

CO2: Isolate screen and identify mutants

CO3: Carryout the process of conjugation and protoplast fusion in Bacteria

List of Practicals

1. Extraction and isolation of DNA (plasmid DNA and genomic DNA).
2. Estimation of DNA.
3. Estimation of RNA.
4. Determination of molecular weight of DNA, resolved on agarose gel electrophoresis.
5. Screening and isolation of mutants, replica plating technique.
6. Conjugation in bacteria.
7. Protoplast preparation, fusion and regeneration.

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MODEL QUESTION PAPER - PRACTICAL

Course Code: P24/MIC/DSC/201 /P **Max Marks: 50**

Credits: 2 **Time: 3 Hrs**

I. Write down the principles involved in major and minor experiments.	**7 + 3 = 10 M**
II. Isolate the DNA form the culture provided and determine its purity.	**10 M**
III. Estimate the concentration of RNA provided	**5 M**
IV. Identify the given spots (A-E) and write few significant points	**5 x 3 = 15 M**
V. Record	**5 M**
VI. Viva	**5 M**

Prepared by Faculty	Checked & Verified by HoD	Approved by the Principal
D.Sunitha	Dr. P. Roselin	Dr. Uma Joseph

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SEMESTER - II
SOIL & ENVIRONMENTAL MICROBIOLOGY – THEORY

1.Course Description:

Programme: M.Sc.
Course Code: P24/MIC/DSC/202
Type of course: DSC
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2. Course Objectives:

- To impart knowledge about structure, composition and functioning of microbial communities of diverse environment.
- The potential use of microbes in biogeochemical cycling, management of various types of pollutants can be studied. The course also helps to describe the role of microbes in solid and liquid waste management.

3. Course Outcomes:

CO1: Understand the type of microorganisms found in soil, air, terrestrial habitat, remember their significance and analyze the salient features about microbes thriving in extreme habitat. (L I, II, IV)

CO2: Understand the geochemically, environmentally significant processes that are contributed by the activities of microorganisms, like the carbon cycle; memorize and create awareness of the role of microbes in Nitrogen cycle & Phosphorous cycle. (L I, II)

CO3: Understand the microbial processes that are relevant for many biotechnological applications (e.g. wastewater treatment, bioenergy production, water quality management) and analyze the role of microorganisms in bioremediation. (L II, IV)

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4.Course Content:

MODULE I - TERRESTRIAL & EXTREME HABITAT: (15 Hrs)

Soil profile and soil microflora, Physical & Chemical Characteristics of Soil, Significance of Soil microflora.
Aero microflora and dispersal of microbes, Extrinsic, Intrinsic sites, Significance of air microflora.
Animal Environment: animal (ruminants) body & Symbiotic association
Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, osmotic pressures, salinity.

MODULE II - BIOGEOCHEMICAL CYCLING: (15 Hrs)

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin
Nitrogen cycle: Nitrogen fixation- Symbiotic & Asymbiotic Nitrogen Fixation, ammonification, nitrification, denitrification and nitrate reduction.
Phosphorus cycle: Phosphate immobilization and solubilization.

MODULE III- SOLID WASTE MANAGEMENT, MICROBIOLOGY OF WATER & BIOREMEDIATION: (15 Hrs)

Liquid waste management: Composition and strength of sewage, Septic tanks, Primary, Secondary: oxidation ponds, trickling filter, activated sludge process and tertiary sewage treatment. Methods of solid waste disposal (Composting and sanitary landfill)
Microbiology of potable water.
Sanitary quality of water: MPN, Standard coliform test, Defined substrate test, Biochemical test.
Water pollution due to degradation of organic matter.
Bioremediation technologies- In situ – Biosparging, Bioventing, Bio augmentation & Ex situ bioremediation- Solid waste & Slurry waste Treatment, Advanatages & Limitations.

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5.Resources:

Text Books:

1. R.C. Dubey, D.K Maheshwari (1999). Text book of Microbiology, 1st Edition S. Chand Publishers.
2. Michael. J. Pelczar, E.S. Chan, Noel. R. Krieg (1993). Microbiology 5th edition, Tata Mc Graw –Hill edition.
3. Alexander Martin. Text Book of Soil Microbiology, Krieger Publication.
4. D. R.C Dubey (1993). Text Book of Biotechnology 1st edition, S. Chand Publishers.

Reference Books:

1. Ed. Benjamin-Cummings (1981) Microbial ecology, Fundamentals and Applications, 4th edition,
Addison-Wesley Publishers.
2. Henze, M.Waste water treatment – Biological and chemical process by Henze, M. Springer-Verlag Berlin Heidelberg.
3. Martin Alexander, (2001). Biodegradation and Bioremediation 2nd editionAcademic Press
J.M. Helawell (1986). Biological indicators of freshwater pollution and environmental management. Elsevier Applied Science Publishers, London.
4. F. Mason (1996). Biology of freshwater pollution. 3rd edition. Longman Group.
5. P D Sharma, Environmental Microbiology, Narosa Publishing house.
6. Gopal Reddy *et al*, (2008). Laboratory experiments in Microbiology3rd edition, Himalaya Publishers.
7. Prescott, Harley and Klein Wim. (2002), Laboratory exercises in Microbiology, Mc Graw Hill Publishers.
8. R.C Dubey, D.K Maheshwari, Practical Microbiology, S Chand and Company.
9. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited

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6. Syllabus Focus

a) Relevance to Local , Regional , National and Global Development Needs

Local /Regional/National	Relevance
National	Soil and environmental microbiology are highly relevant to society due to their crucial roles in various aspects of life like nutrient recycling, decomposition of organic matter, environmental conservation and managing the health risks associated with water contamination. It can provide insight into how soil ecosystems respond to climate change and how they can be managed to mitigate its effects.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	**Description of Activity**
Skill Development & Employability	Module 3	Skill & Employability Development Content – Understand and attain proficiency in various sectors related to water quality assessment, including environmental monitoring, public health, water treatment etc. Additionally, possessing these skills contributes to ensuring the safety and sustainability of water resources for communities and ecosystems. Activity Assessment of water quality, Model Presentations.

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7.Pedagogy:

S. No	Student Centric Methods Adopted	Type/Description of Activity
1.	Assignments	Participative Learning
2.	Model Presentation	Experiential Learning

8.Course Assessment Plan:

a.Weightage of Marks in Continuous Internal Assessments and End Semester Examination

COs	Continuous Internal Assessments– CIA 40%)	End Semester Examination (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1	
C03	CIA-2 (Models/ Assignments)	

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b. Question Paper Pattern:

SOIL & ENVIRONMENTAL MICROBIOLOGY
MODEL QUESTION PAPER – THEORY

Course Code: P24/MIC/DSC/202 **Max Marks: 60**
Credits: 3 **Time: 2½ Hrs**

SECTION – A

Answer the following: **3x 12 = 36M**

1. Think and analyze the conditions you may find in hot sulphur springs. What type of organisms would you expect to find there and explain its physiology and molecular adaptations.

OR

2. Illustrate and describe soil profile. Explain the physical, chemical and biological properties of soil.

3. Describe in detail the microbiological degradation of cellulose.

OR

4. Explain and illustrate in detail the process of symbiotic nitrogen fixation.

5. Explain the role of microbes in In- situ bioremediation and summarize the advantages of bioremediation.

OR

6. Describe the various sanitary quality tests to analyze the quality of water. Explain and illustrate the standard coliform test in detail.

SECTION – B

Answer any FOUR: **4 x 6= 24M**

7. Explain the Significance of air Microflora
8. Analyse the significance of Rumen Microflora
9. Describe the Phosphorous cycle
10. Explain the biochemistry of Denitrification and highlight its significance in ecosystem
11. Explain the application of Cesspools
12. Describe the microbiology of Composting

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Think and analyze the conditions you may find in hot sulphur springs. What type of organisms would you expect to find there and explain its physiology and molecular adaptations.	CO 1	Level IV
2	Module 1	Illlustrate and describe soil profile. Explain the physical, chemical and biological properties of soil.	CO 1	Level II
3	Module 2	Describe in detail the microbiological degradation of cellulose	CO 2	Level II
4	Module 2	Explain in detail the process of symbiotic nitrogen fixation.	CO 2	Level II
5	Module 3	Explain the role of microbes in In- situ bioremediation and summarize the advantages of bioremediation.	CO 3	Level II
6	Module 3	Describe the various sanitary quality tests to analyze the quality of water. Explain and illustrate the standard coliform test in detail.	CO 3	Level II, IV
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			**4 Q X 6M = 24M**	
7	Module 1	Explain the Significance of air Microflora	CO 1	Level II
8	Module 1	Analyse the significance of Rumen Microflora	CO 1	Level IV
9	Module 2	Describe the Phosphorous cycle	CO 2	Level II
10	Module 2	Explain the biochemistry of Denitrification and highlight its significance in ecosystem	CO 2	Level II
11	Module 3	Explain the application of Cesspools	CO 3	Level II
12	Module 3	Describe the microbiology of Composting	CO 3	Level I

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SEMESTER - II
SOIL & ENVIRONMENTAL MICROBIOLOGY - PRACTICAL

1. Course Description:

Course Code: P24/MIC/DSC/202/P
Type of course: DSC
No. of credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2. Course Objectives:

- The course helps in understanding the microbial activity in soil and their role in biogeochemical cycles.
- Gives practical skills on analyzing the quality of water.

3. Course Outcomes:

CO1: Isolate cellulose degrading microbes and evaluate the cellulase activity and attain practical exposure to isolate microbes involved in the processes of ammonification, denitrification and nitrification.

CO2: Perform COD and analyze the quality of water.

CO3: Isolate metal, pesticide tolerant microbes and analyze their role in bioremediation.

List of Practicals

1. Estimation of soil microbial activity by CO_2 evolution
2. Isolation of cellulose decomposing microbes and estimation of cellulase activity
3. Estimation of ammonifiers in soil by MPN Method
4. Estimation of nitrifiers in soil by MPN Method
5. Estimation of denitrifies in soil by MPN Method.
6. Testing for microbial sanitary quality of water (coliform test)
7. Determination of COD of water
8. Isolation and observation of air microflora

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MODEL QUESTION PAPER - PRACTICAL

Course Code: P24/MIC/DSC/202/P **Max Marks: 50**

Credits: 2 **Time: 3 Hrs**

I. Write down the principles involved in major and minor experiments. 5 + 5 = 10 M

II. MAJOR 10 M

1ml of enzyme cellulase when incubated with 1mg of cellulose powder suspension for 6 hours liberated 0.6mg of glucose. Estimate the amount of cellulase and calculate the enzyme activity. (Std enzyme concentration is 5mg/ml).

III. MINOR 5 M

The cultures *E. coli* and Bacillus were treated with different concentrations of the pesticide Monocil. Determine the resistance or susceptibility of the organisms to the pesticide in the given plate and comment on it.

III. Identify the given spots A-E and write few significant points 5 x 3 = 15 M

IV. Record 5 M

V. VIVA 5 M

Prepared by Faculty	Checked & Verified by HoD	Approved by the Principal
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SEMESTER - II

VIROLOGY & PARASITOLOGY - THEORY

1.Course Description

Programme: M.Sc.
Course Code: P24/MIC/DSC/204
Course Type: DSC
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2.Course Objectives:

- To understand the structure, mode of infection, replication and transmission of viruses.
- To impart knowledge about viral protozoal and fungal diseases.

3.Course Outcomes:

CO1: Understand the morphology, classification, cultivation methods of viruses, analyze purification methods, assay of viruses and subviral agents. (L II, IV)

CO2: Understand the knowledge of human DNA, RNA viruses, retro, oncogenic and animal viruses. (L II)

CO3: Understand the knowledge of plant viruses, Algal virus, Mycovirus, Bacterial viruses. Protozoal diseases and Superficial mycosis. (L II)

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4. Course Content :

MODULE I - GENERAL VIROLOGY: **(15 Hrs)**

Distinctive properties of viruses: size, acellular organization, nature of viral genome, morphology and ultra-structure of viruses: Capsids: icosahedral (Adeno virus), helical (Tobacco Mosaic Virus), envelope (Influenza virus), glycoprotein, matrix proteins, viral genome (dsDNA, dsRNA, ssDNA, ssRNA). Classification, methods of transmission and cultivation of viruses: embryonated egg, experimental animals and cell cultures). Purification of viruses: Physical, chemical methods and density gradient centrifugation. Assay of viruses: Infectivity assay methods (plaque, pock), physical (EM), serological (HA, HI) and chemical (viral protein and nucleic acid based) approaches. Virus related agents (viroids, virusoids, prions).

MODULE II - HUMAN AND ANIMAL VIRUSES: **(15 Hrs)**

Clinical presentation, diagnosis, life cycle, replication, pathogenesis, prevention and treatment of: DNA viruses (Herpes, Pox, Adeno), RNA viruses (rabies, Polio, Influenza, Coronavirus, retrovirus/lentivirus (HIV); Oncovirus (HBV), Mechanism of virus host interaction; Interferon, antiviral agents.
Clinical presentation, diagnosis, replication strategy, pathogenesis, prevention and treatment of Farm animal viral diseases: Foot and Mouth Diseases, Rabies, New Castle Disease virus.

MODULE III PLANT VIRUSES, BACTERIOPHAGES AND PARASITOLOGY: (15 Hrs)

Plant viral diseases: - Tobacco mosaic virus (TMV), Cauliflower mosaic virus (CaMV); Gemini virus – Begomo virus; Tospo virus- Tomato spotted wilt virus, Mycovirus (Ex: Botrytis virus F), Algal virus (Ex: Raphidovirus), Bacteriophages: RNA (MS2) and DNA (T4 and T7, lambda, Øx174, M13). Causative agents, morphological, pathogenic characters and methods of diagnosis, prevention and control of the following parasitic diseases - Protozoal diseases: Amoebiasis, Malaria, Giardiasis and Trichomoniasis; Fungal diseases: Superficial mycosis: Surface infection and cutaneous infection

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5. Resources:

Text books:

1. Jawetz, Melnick and Adelberg's. (2007). Medical Microbiology. 24th ed. McGraw Hill Medical.
2. Edward K. Wagner and Martinez J. Hewlett. (2004). Basic Virology. 2nd ed. Blackwell Science.
3. Biswas SB and Amita Biswas. (1996). An introduction to viruses. 4th ed. Vikas Publishing Publishing House.
4. Michael T. Madigan. (2014). Brock Biology of Microorganisms: International Edition. 14th Edition. Benjamin Cummings.
5. Blood D. C. and Henderson J. A. (1983). Veterinary medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 6th Edition. Baillière Tindall.
6. Chatterjee K.D. (2009). Parasitology Protozoology & Helminthology. 13th Edition. CBS *Publishers* and Distributors.
7. Ananthanarayan & Paniker. (2009). A textbook of Microbiology. 8th Edition. Universities Press.

Reference Books:

1.White D.E and Frank J. Fenner. (1994). Medical Virology. 4th Edition. Academic Press.\

2.Jane Flint S, Lynn W. Enquist, Vincent R. Racaniello and Anna Marie Skalka. (2008). Principles of Virology. 3rd Edition. ASM Press.

3.Charles H Cunningham. (1977). A Laboratgory Guide in Virology. 7th Edition. Burgess *Publishing* Co.

4.Basic Lab Procedures in Diagnostic Virology by Marty Cristensen. CBS *publishers.*

5.Steven C. Specter, Richard L. Hodinka, Danny L.Wiedbrauk and Stephen A.Young. (2009). Clinical Virology Manual. 4th Edition. ASM Press.

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6. **Syllabus Focus:**

a. Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
National	Support healthcare improvements, economic stability, agricultural productivity, environmental sustainability, and international cooperation, thereby contributing to the overall well-being and development of the nation.

b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Entrepreneurship Development	Module II	Can inspire the creation of startups focused on developing new vaccines, antiviral drugs, diagnostic tools, and treatments for parasitic diseases. Knowledge in these areas is crucial for identifying market needs and developing innovative products.

7. **Pedagogy:**

S. No	Student Centric Methods Adopted	Type / Description of Activity
1	Interactive class room quiz	Experiential Learning
2	Presentation	Participative Learning

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8. Course Assessment Plan

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1	End semester exam
CO2	CIA-2 (Poster presentation)	
CO3	CIA-2 (Assignment)	

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b. Question Paper Pattern:

VIROLOGY & PARASITOLOGY
MODEL QUESTION PAPER – THEORY

Course Code: P24/MIC/DSC/204 **Max Marks: 60**
Credits: 3 **Time: 2 ½ Hrs**

SECTION – A

I. Answer the following: **3 x 12 = 36M**

1. Describe the cultivation of viruses using embryonated chicken egg.

OR

2. Delve into the mechanisms and principles underlying different viral isolation strategies, such as cell culture, embryonated eggs, and animal models, and critically assess the strengths and limitations of each approach.

3. Describe pathogenesis, clinical symptoms, diagnosis and preventive measures of HIV virus.

OR

4. Explain the structure, pathogenesis, clinical symptoms of Influenza virus

5. Illustrate the structure, clinical symptoms and preventive measures of TMV.

OR

6. Explain the morphological features, pathogenesis and life cycle of Entamoeba histolytica.

SECTION – B

II. Answer any four 4 x 6M = 24 M

7. Explain Hemagglutination assay
8. Describe Sub-viral agents
9. What is Interferon
10. Explain Structure of Pox virus
11. Explain Structure of CaMV
12. Describe Erythrocytic cycle

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Describe the cultivation of viruses using embryonated chicken egg.	CO 1	Level II
2	Module 1	Delve into the mechanisms and principles underlying different viral isolation strategies, such as cell culture, embryonated eggs, and animal models, and critically assess the strengths and limitations of each approach.	CO 1	Level IV
3	Module 2	Describe pathogenesis, clinical symptoms, diagnosis and preventive measures of HIV virus	CO 2	Level II
4	Module 2	Explain the structure, pathogenesis, clinical symptoms of Influenza virus	CO 2	Level II
5	Module 3	Illustrate the structure, clinical symptoms and preventive measures of TMV	CO 3	Level II
6	Module 3	Explain the morphological features, pathogenesis and life cycle of Entamoeba histolytica.	CO 3	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			4 Q X 6M = 24M	
7	Module 1	Explain Hemagglutination assay	CO 1	Level I
8	Module 1	Describe Sub-viral agents	CO 1	Level I
9	Module 2	What is Interferon	CO 2	Level II
10	Module 2	Explain Structure of Pox virus	CO 2	Level II
11	Module 3	Explain Structure of CaMV	CO 3	Level II
12	Module 3	Describe Erythrocytic cycle	CO 3	Level I

c. Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks

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9. **CO-PO Mapping**

CO	PO	Cognitive Level	Classroom sessions (hrs)
1	1, 2	Understand, Remember, Analyze, Apply	15
2	1, 2	Understand, Apply, Analyze,	15
3	1, 2	Understand, Apply, Evaluate	15

SEMESTER – II

VIROLOGY & PARASITOLOGY – PRACTICAL

1. **Course Description:**

Course Code: P24/MIC/DSC/204/P
Type of course: DSC
No. of credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To impart the practical knowledge of isolation of viruses by different methods.
- To understand cultivation of viruses by different methods and impart the knowledge of diseases caused by viruses, protozoa and fungi.

3.Course Outcomes:

CO1: Understand the isolation and detection method of bacteriophages and impart the knowledge of hemagglutination assay and ELISA.

CO2: Correlate the application of virus inoculation techniques in embryonated eggs.

CO3: Impart the knowledge of diseases caused by viruses, protozoa and fungal disease.

List of Practicals

1. Isolation of Bacteriophage from soil / sewage (plaque assay).
2. Determination of bacteriophage titre.
3. Hemagglutination assay.
4. Estimation of chlorophyll pigments in healthy and viral diseased plants
5. Cultivation of viruses - Egg inoculation (CAM, Allantoic, Amniotic route inoculation).
6. Animal inoculation techniques – Field Trip.

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7. Viral diseases: SLIDES – TMV, T – even phage, Adenovirus, Rhabdovirus, HIV, Orthomyxovirus, CPE of Rabies virus.
8. Protozoal diseases: SLIDES – *Plasmodium, Entameoba histolytica.*
9. Fungal diseases: SLIDES - *Aspergillus, Candida Albicans.*
10. Immunodiagnosis - ELISA tests
11. Detection of plant viruses by ELISA method.
12. Diagnosis of viral diseases (ROTA virus) by KIT method – Online video presentation.

MODEL QUESTION PAPER – PRACTICAL

Course Code : P24/MIC/DSC/204/P **Max. Hours: 60**
Course Type: DSC **Hours per week: 4**
No. of Credits: 2 **Max. Marks: 50**

I. MAJOR **10 M**

Demonstrate the following route of inoculation using Methylene Blue Dye:
a. Allantoic
b. Amniotic
c. CAM.

II. MINOR **10 M**

3. Analyze the given data, Calculate, Interpret the results of the chlorophyll a. estimation.
(or)
2. Analyze the given data, Calculate, Interpret the results of PFU.

III. Identify the given spots A-E and write few significant points **5 x 2 = 10 M**

IV. Record **5 M**

V. VIVA **5 M**

Prepared by Faculty	Checked &Verified by HoD	Approved by the Principal
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